

DRAFT FINAL

**ENGINEERING EVALUATION/COSTS ANALYSIS
SITE 17 - FIREFIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD,
FENTRESS, VIRGINIA**

CONTRACT TASK ORDER 0224

Prepared For:

**NAVAL FACILITIES
ENGINEERING COMMAND
ATLANTIC DIVISION
Norfolk, Virginia**

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1.0 INTRODUCTION

This report presents the Engineering Evaluation and Cost Analysis (EE/CA) of Removal Action alternatives for the Firefighting Training Area (Site 17) at the Naval Auxiliary Landing Field (NALF), Fentress, Virginia. Figure 1-1 presents the location of NALF-Fentress. Figure 1-2 provides a detailed site location map for Site 17. Figure 1-3 depicts Site 17. This EE/CA was prepared for the Atlantic Division (LANTDIV), Naval Facilities Engineering Command by Foster Wheeler Environmental Services (FWES) as part of the Baker Environmental, Inc. Team, under the Comprehensive Long Term Environmental Action Navy (CLEAN) Program, Contract No. N62470-89-D-4814, Contract Task Order (CTO)-0224.

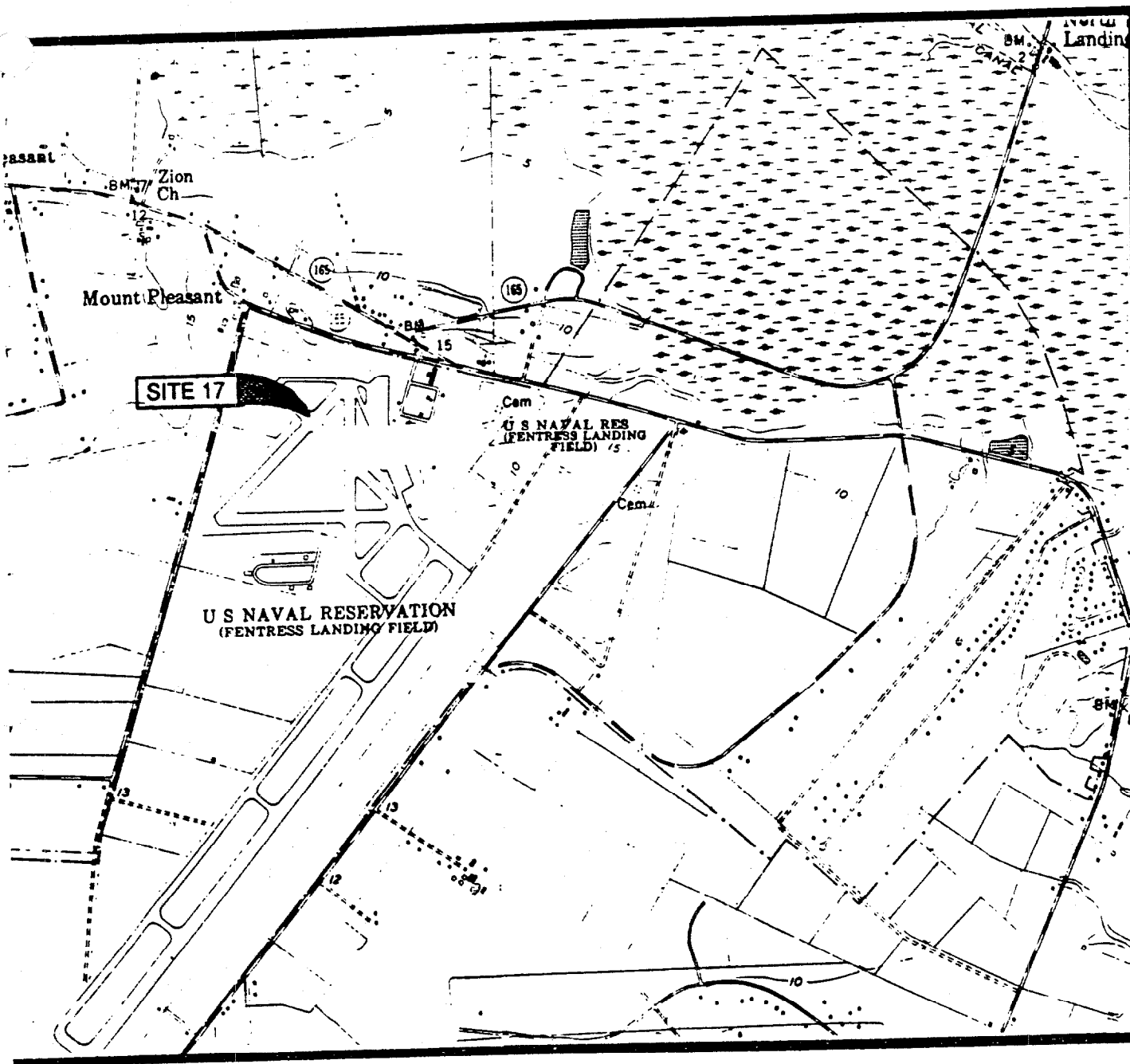
This EE/CA and the peripheral documents (Fact Sheet and Decision Document) are based on site investigations conducted to-date, which included an Initial Assessment Study (IAS) dated December 1984, an Environmental Investigation dated March 1991, a Site Investigation Report (SI) dated July 31, 1992, and a Supplemental SI dated October 1, 1993. The SI and Supplemental SI were conducted by the Baker Team between December 1991 and April 1993. These investigations have identified areas, at the NALF Site 17, containing constituents of concern in soils at or above concentrations requiring removal action.

This EE/CA has been prepared in accordance with the Final Implementation Plan and Fee Proposal (IP/FP) "Engineering Evaluation and Cost Analysis - Site 17, Firefighting Training Ring," dated November 3, 1993.

1.1 Purpose and Objective

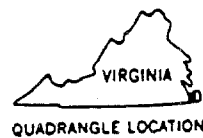
The purpose of this EE/CA is to evaluate the potential Site 17 removal alternatives for effectiveness, implementability, and construction cost.

The objective of this EE/CA is to provide a brief analysis of alternatives, for a site where removal action may be deferred for six months or more, to support the six month planning and evaluation period. The Department of the Navy (DON) has broad authority under CERCLA Section 104 and Executive Order 12580 to carry out removal actions when an action is necessary due to the release on or from a DON installation. This EE/CA is conducted following the removal program guidelines of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), the National Oil and Hazardous Substances Contingency Plan (NCP), and the USEPA's Guidance for Non-Time-Critical Removal Actions dated June 1987, modified on August 1993.



**FIGURE 1-1
SITE LOCATION MAP**

**SITE 17 - FIREFIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD
FENTRESS, VIRGINIA**



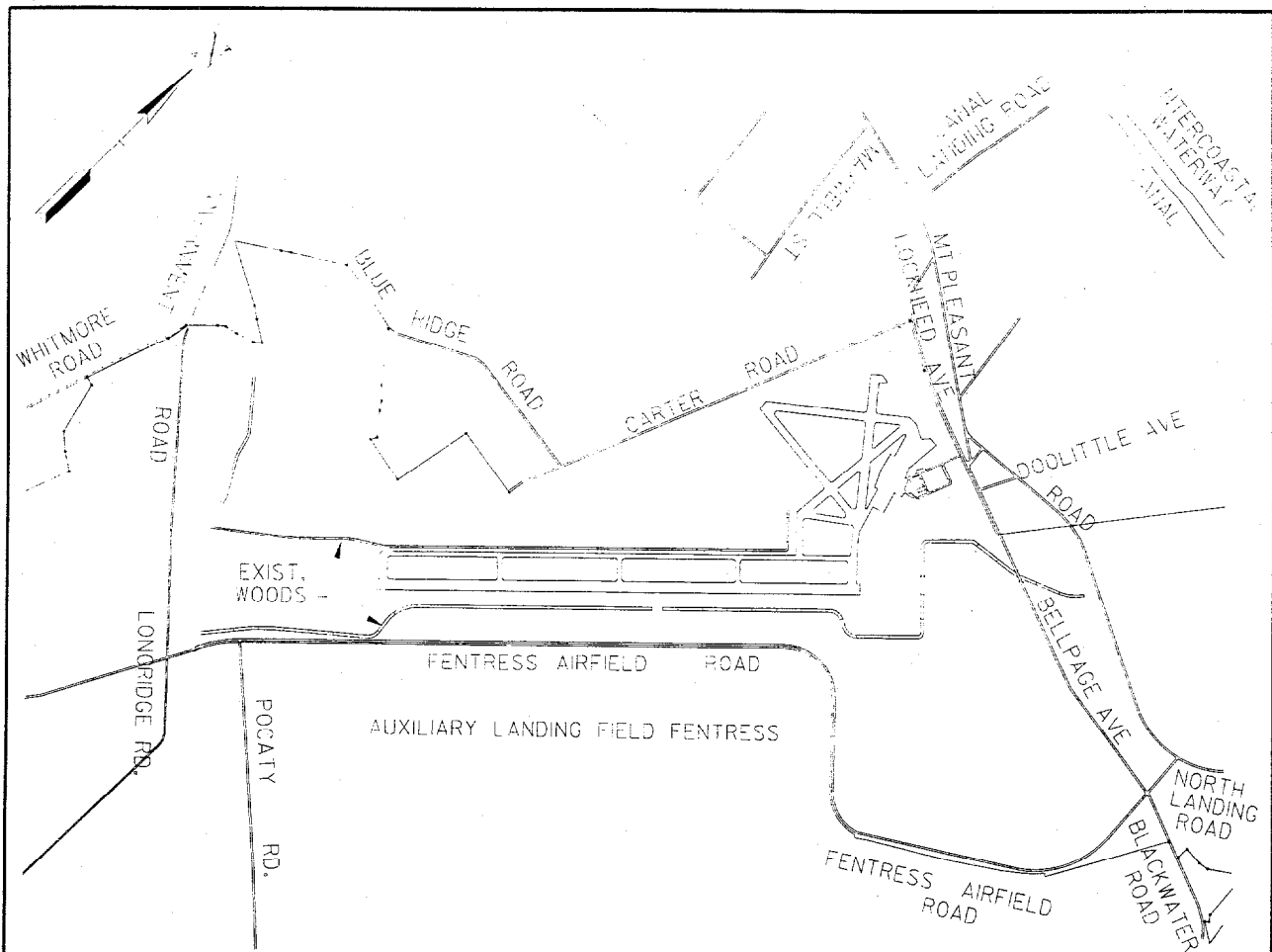
UTM GRID AND 1986 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

180 MILS
0°43' 13 MILS

**Fentress and Pleasant Ridge VA Quadrangles
7.5 Minute Topographic Series**

Prepared by:
Foster Wheeler Enviroresponse, Inc.

Scale: 1" = 2000'



GRAPHIC SCALE

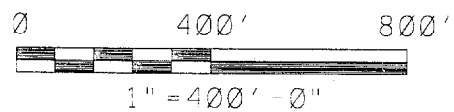


FIGURE 1-2
DETAILED SITE LOCATION MAP
SITE 17
FIREFIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD
FENTRESS, VIRGINIA

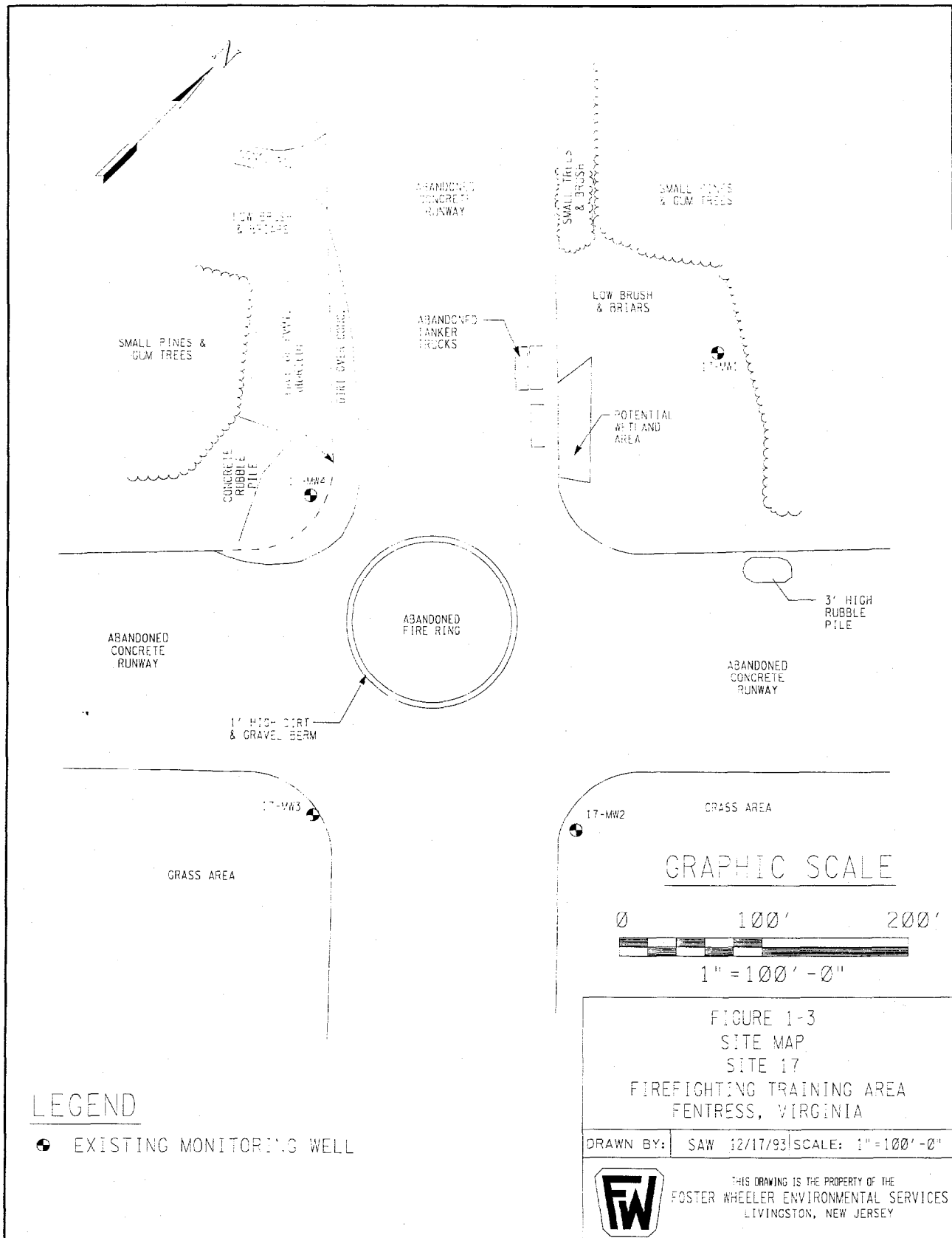
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With respect to the Navy/Marine Corps Installation Restoration (IR) Program, this EE/CA also follows the guidelines published in the Navy/Marine Corps IR Manual dated February, 1992. The Navy/Marine Corps IR Program was initiated in order to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Installations.

1.2 Report Organization

A detailed description of the site, its background, the investigations to date and the nature and extent of contamination is presented in Section 2.0 of this report. Section 3.0 defines the objectives of the removal action. Section 4.0 identifies and briefly describes potential removal action alternatives for the constituents of concern at Site 17. Section 5.0 provides a detailed analysis of each of the identified alternatives with respect to effectiveness, implementability, and costs to implement. Section 6.0 provides the basis for recommendation of an action by comparative analysis of each alternative. Section 7.0 describes the proposed recommended action.

2.0 SITE BACKGROUND

2.1 Site History

The NALF was established during World War II and served as a U.S. Naval Air Landing Field from the mid 1940's to 1970. Presently, the facility is used as a training site for Navy personnel and is maintained and operated by the Navy. The landing strip is used for training police recruits from Chesapeake and Virginia Beach, Virginia. The facility currently provides air training services for operations and command/control of fleet units and other Department of Defense (DOD) agencies in the Atlantic.

Site 17, located at the intersection of two abandoned aircraft runways, was used as a training area where jet fuel and spent oils were ignited to teach firefighting skills to Navy personnel (CH₂M Hill, 1991). Site 17 is currently abandoned. Site 17 is depicted, with monitoring well and soil boring locations, on Figure 2-1.

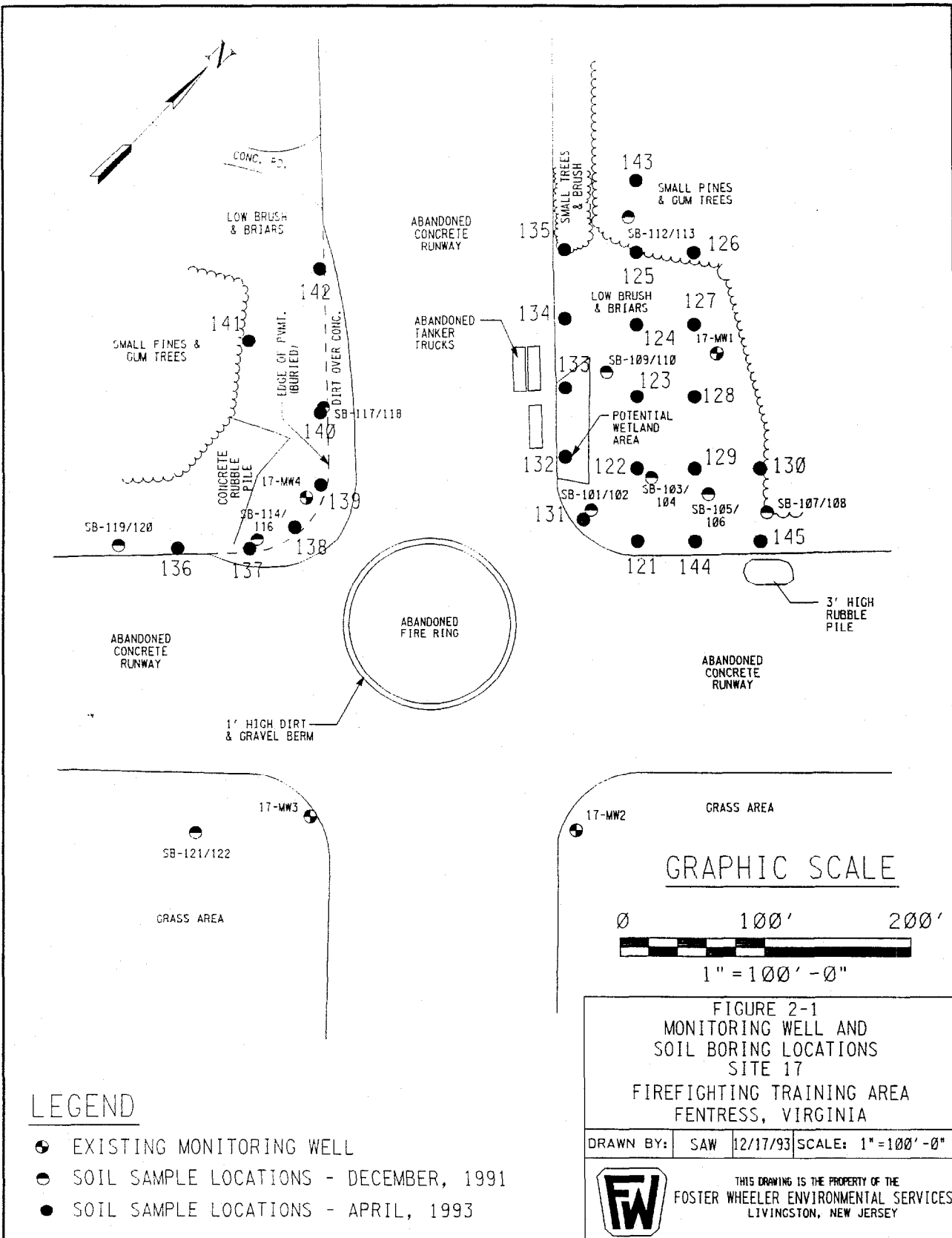
2.2 Environmental Location and Setting

The NALF is located in Fentress, Virginia, in the City of Chesapeake at longitude 76°07'30" west and latitude 36°42'30" north. The local terrain is flat, with relief varying between ten and fifteen above mean sea level, over much of the facility. Surface water runoff is managed by a system of drainage ditches and surface channels, which direct runoff north and east of the facility towards the Intercoastal Waterway.

2.3 Geology

NALF-Fentress is situated on the outer edge of the Atlantic Coastal Plain physiographic province. The Atlantic Coastal Plain is a broad wedge of unconsolidated sediments that dip and thicken to the east. The sediments consist of several thousand feet of unconsolidated sand, clay, silt, and gravels and are underlain by granite basement rock. From oldest to youngest, the five principal sedimentary units are the Potomac Formation, unnamed Upper Cretaceous deposits, the Pamunkey Group, the Chesapeake Group, and the Columbia Group (Meng and Harsh, 1984).

The Columbia Group sediments and the uppermost portion of the Chesapeake Group or the Yorktown Aquifer, comprise one of the principal aquifers used locally for water supply. The Yorktown Aquifer is described as



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consisting of interbedded shell-rich layers of very fine to coarse sands, clayey sands and sandy clay (Sidulya, et al. 1981). Regionally, a layer of silt and clay separates the Yorktown Aquifer from the sediments of the Columbia Group. This clay layer has been designated as the Yorktown Confining Unit by Meng and Harsh (1984), because of its role in the regional hydrogeology. At Fentress, the Yorktown Confining Unit was identified as being a layer of olive-gray clay and silty clay 15-feet thick, which was encountered at approximately 30 feet below the land surface. The Yorktown Aquifer, was encountered at approximately 45 feet below the land surface, directly beneath the Yorktown Confining Unit. The aquifer consists primarily of gray, very fine to medium sand, and in some cases coarse sand and gravel.

The sediments of the Columbia Group comprise the surface materials and consist of interbedded gravels, sands, silts, and clays. In the vicinity of Fentress, the thickness of these sediments is less than 30 feet, and typically the depth to groundwater is relatively shallow, less than 10 feet below the land surface. As a result, an unconfined aquifer with a saturated thickness of approximately 20 feet is present in the sediments beneath NALF-Fentress.

The site lies wholly within the embayed section of the Atlantic Coastal Plain Province which includes coastal areas from eastern New York to Central North Carolina. The area is underlain by unconsolidated sediments that dip gently eastward to the sea and rest upon a basement-rock complex of Pre-Cretaceous Age.

2.4 Hydrology

The site is located in a low lying area. Surface water bodies at Site 17 consist of intermittent ponding on the north corner of the site. During wet periods, the north corner contains stagnant surface water runoff. Due to the poor drainage properties of the soils, ponding occurs for periods of one or more weeks.

2.5 Soils

Surficial soils at the site are primarily organic rich (humic) material. Borings were drilled during previous investigations to a depth of four feet at Site 17. No deep borings were drilled at Site 17. Soils in this interval are described as dark brown in color at the surface, tending to light grayish-green, clay material at a depth of two feet and below.

2.6 Groundwater

Monitoring wells at Site 17 were drilled during previous investigations and were initially sampled during March 1991. Results of previous water-level measurements taken in all four Site 17 wells indicate that the principal direction of shallow groundwater flow is to the west with a shallow hydraulic gradient. Static water level measurements were collected on December 10 and 16, 1991. Static water levels collected from wells 17GW-01 through 17GW-04 indicate groundwater movement is primarily to the west. Static water levels range from 4.98 to 7.18 feet below top of casing.

2.7 Previous Site Investigations

Previous site investigations conducted at Site 17 included the installation of monitoring wells, and collection and analysis of groundwater, soil gas, and soil samples. The following reports of previous investigations are applicable to this report:

- "Initial Assessment Study of Naval Air Station, Oceana, Virginia Beach, Virginia, NEESA B-067," dated December 1984 and prepared by Naval Energy and Environmental Support Activity (NEESA), Port Hueneme, California;
- "Environmental Investigation of the Landfill and Firefighting Training Area Auxiliary Landing Field, Fentress, Chesapeake, Virginia, Draft Report," dated March 1991, and prepared by CH₂M Hill, Inc.; and,
- "Site Inspection Report, Site 14 - Fentress Landfill, Site 17 - Firefighting Training Area and Naval Auxiliary Landing Field," dated July 31, 1992, and prepared by Baker Environmental/Foster Wheeler Enviresponse.

Figure 2-1 presents a comprehensive map of the sampling locations of the previous studies. Tables 2-1 through 2-6 present summaries of constituents detected at these locations. The constituents of concern for analysis were initially selected in order to provide a comprehensive screening of the sites. These constituents included Target Compound List (TCL) volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), Total Petroleum Hydrocarbons (TPHs), Lead, BNAs, and ignitability for Site 17.

The analytical results from the investigation provided the basis for this EE/CA. The data was compared to U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs), Commonwealth of Virginia Department of Waste Management "Guidelines for the Disposal of Soil Contaminated with Petroleum Products", and the Commonwealth of Virginia State Water Control Board Regulations (VAWCBR) water quality standards. The following sections provide a summary and interpretation of the analytical results for the previous site investigations.

2.7.1 Soils and Soil Gas

The following provides results of previous soil sampling at site 17.

Site Inspection

VOCs, SVOCs, and TPHs were detected at Site 17 during the Site Inspection (SI). These constituents were found to the north and west sides of the intersection of the existing concrete runways. TPHs were detected above 100 mg/kg in ten soil samples in the northerly corner and in three soil samples in the westerly corner. A summary of this data is presented on Table 2-1.

Supplemental Site Investigation

During the Supplemental Site Investigation (SSI), soil gas samples were collected and analyzed. Subsequently, confirmatory soil samples were collected and analyzed. The SSI was the Final Round of investigation at Site 17 to-date.

TABLE 2-1

SOIL ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS
SITE 17 - FIRE FIGHTING TRAINING
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
DECEMBER 13, 1991

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-101 SB-101 4 Soil mg/kg	(Dup.17-SB-101) SB-101 4 Soil mg/kg	17-SB-102 SB-102 4 Soil mg/kg	17-SB-103 SB-103 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	1,200	1,400	480	5,800

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-104 SB-104 4 Soil mg/kg	17-SB-105 SB-105 4 Soil mg/kg	17-SB-106 SB-106 4 Soil mg/kg	17-SB-107 SB-107 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	1,400	330	130	

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-108 SB-108 4 Soil mg/kg	17-SB-109 SB-109 4 Soil mg/kg	17-SB-110 SB-110 4 Soil mg/kg	17-SB-111 SB-111 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED		360	1,600	2,700

NOTES:

Blank indicates compound was Not Detected
mg/kg indicates milligrams per kilogram
Dup. indicates duplicate sample

TABLE 2-1 (CONTINUED)

SOIL ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS
SITE 17 - FIRE FIGHTING TRAINING
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
DECEMBER 13, 1991

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-112 SB-112 4 Soil mg/kg	17-SB-113 SB-113 4 Soil mg/kg	17-SB-114 SB-114 4 Soil mg/kg	17-SB-115 SB-115 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	1,700	160	46	65

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-116 SB-116 4 Soil mg/kg	17-SB-117 SB-117 4 Soil mg/kg	17-SB-118 SB-118 4 Soil mg/kg	17-SB-119 SB-119 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	210	330	260	74

SAMPLE LOCATION SAMPLE BORING LOCATION SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-120 SB-120 4 Soil mg/kg	17-SB-121 SB-121 4 Soil mg/kg	17-SB-122 SB-122 4 Soil mg/kg
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED		NA	NA

NOTES:

Blank indicates compound was Not Detected
mg/kg indicates milligrams per kilogram
Dup. indicates duplicate sample
NA indicates Not Analyzed

A total of 33 soil gas samples were taken in the northerly and westerly corners of the site. Soil gas samples were analyzed for BTEX and total flame-ionization detectable volatiles. 5 of 33 soil gas samples contained detectable constituents. Table 2-2 summarizes soil gas samples analytical results.

Based on the results of all previous soil investigations, including the soil gas sample results, 25 soil borings and 49 soil samples were collected and analyzed. The soil samples were collected at two different depths at and directly adjacent to the soil gas samples containing detectable constituents. Soil samples were to be collected at depths between zero and two feet below ground surface (bgs) and between five and seven feet bgs. However, soil samples were collected at depths between zero and two feet bgs and between two and four feet bgs because of the high groundwater table. The soil samples were analyzed for TPHs, BTEX, TCL VOCs and SVOCs, and lead. The analytical results for the soil samples are summarized in Tables 2-3 thru 2-6.

2.7.2 Groundwater

Previous groundwater sample results indicated the presence of (TPHs) and associated volatile organic compounds (VOCs) in the groundwater. However, these constituents were not detected at concentrations above USEPA MCLs.

2.7.3 Surface Water

As indicated in Section 2.4, surface water is only intermittently present at Site 17. Consequently, surface water samples were not collected at Site 17.

TABLE 2-2

OC-00139-02.05-02/07/94

SOIL GAS ANALYTICAL RESULTS
 ANALYTE CONCENTRATIONS VIA GC/FID¹
 SITE 17 - FIREFIGHTING AREA
 NAVAL AUXILIARY LANDING FIELD - FENTRESS
 FENTRESS, VIRGINIA
 APRIL 26-28, 1993

SAMPLE	DEPTH (ft)	BENZENE μg/L	TOLUENE μg/L	ETHYL- BENZENE μg/L	XYLENES μg/L	TOTAL FID VOLATILES ² μg/L
A-10	5					
A-11	5		1.3	1.5	3.5	53.0
A-12	5		14.0	10.0	22.0	638.0
A-13	5					
A-14	6					
A-15	7					
A-16	8					
B-10	4					
B-11	4					
B-12	5					
B-13	5					
B-14	4					
B-15	4					
B-16	4					
C-10	4					
C-11	4					
C-12	5					11.0
C-13	4		21.0	9.0	19.0	386.0
C-14	4					
C-15	4					
C-16	4					
D-11	4					
D-12	5					
D-13	5	11.0	125.0	10.0	41.0	2360.0
D-14	4					
D-15	4					
E-11	4					
E-12	5					
E-13	5					
E-14	4					
E-15	4					
F-13	5					
F-14	4					
REPORTING LIMIT		1.0	1.0	1.0	1.0	10.0

NOTES:

¹ Analysis performed by TARGET Environmental Services, Inc. in the field utilizing a gas chromatograph/flame ionization device (GC/FID).

² Calculated using the sum of the areas of all integrated chromatogram peaks and the instrument response factor for toluene.

Blank indicates compound was Not Detected.

μg/L indicates micrograms per liter of air.

TABLE 2-3

SOIL ANALYTICAL RESULTS
 TOTAL PETROLEUM HYDROCARBONS
 SITE 17 - FIRE FIGHTING AREA
 NAVAL AUXILIARY LANDING FIELD - FENTRESS
 FENTRESS, VIRGINIA
 APRIL 28 AND 29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-121		17-SB-122		17-SB-123		17-SB-124	
	03		01	03	01	02	01	02
	4 - 6		0 - 2	4 - 6	0 - 2	2 - 4	0 - 2	2 - 4
	Soil		Soil	Soil	Soil	Soil	Soil	Soil
	μg/g		μg/g	μg/g	μg/g	μg/g	μg/g	μg/g
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	380		720	3600	9200	3700	1400	550

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-146 (Dup. 124)		17-SB-125		17-SB-126		17-SB-127	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	800	1700	2400	340			3700	890

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-128		17-SB-147 (Dup. 128)		17-SB-129		17-SB-130	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	4700	1500	3100	3200				

NOTES:

Blank indicates compound was Not Detected

μg/g indicates micrograms per gram.

Dup. indicates duplicate sample

TABLE 2-3 (CONTINUED)

SOIL ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS
SITE 17 - FIRE FIGHTING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28 AND 29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-131		17-SB-148 (Dup. 131)		17-SB-132		17-SB-133	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
METHOD 8015 - MODIFIED	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
	1400	110	1300	2300	4200	1700	310	1600

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-134		17-SB-135		17-SB-136		17-SB-137	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
METHOD 8015 - MODIFIED	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
	3400	1500						

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-149 (Dup. 137)		17-SB-138		17-SB-139		17-SB-150 (Dup. 139)	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
METHOD 8015 - MODIFIED	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
			2100	4300	500	690	320	120

NOTES:

Blank indicates compound was Not Detected

µg/g indicates micrograms per gram.

Dup. indicates duplicate sample

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TABLE 2-3 (CONTINUED)

SOIL ANALYTICAL RESULTS
TOTAL PETROLEUM HYDROCARBONS
SITE 17 - FIRE FIGHTING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28 AND 29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-140		17-SB-141		17-SB-142		17-SB-143	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED	2500	410			110			

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-144		17-SB-145	
	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4
	Soil µg/g	Soil µg/g	Soil µg/g	Soil µg/g
TOTAL PETROLEUM HYDROCARBONS METHOD 8015 - MODIFIED			130	

NOTES:

Blank indicates compound was Not Detected

µg/g indicates micrograms per gram.

Dup. indicates duplicate sample

TABLE 2-4

SOIL ANALYTICAL RESULTS
TOTAL BTEX (BENZENE, TOLUENE, ETHYLBENZENE, AND TOTAL XYLENES)
SITE 17 - FIRE FIGHTING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28 AND 29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-121		17-SB-122		17-SB-123		17-SB-124	
	03		01	03	01	02	01	02
	4 - 6		0 - 2	4 - 6	0 - 2	2 - 4	0 - 2	2 - 4
	Soil		Soil	Soil	Soil	Soil	Soil	Soil
	µg/kg		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TOTAL BTEX: METHOD 8240 Toluene Ethylbenzene Total Xylenes				1900		240 J 1400 2700		
TOTAL BTEX			1900		4340			

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-146 (Dup. 124)		17-SB-125		17-SB-126		17-SB-127	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TOTAL BTEX: METHOD 8240 Toluene Ethylbenzene Total Xylenes		2100						
TOTAL BTEX		2100						

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-128		17-SB-147 (Dup. 128)		17-SB-129		17-SB-130	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TOTAL BTEX: METHOD 8240 Toluene Ethylbenzene Total Xylenes	1300							
TOTAL BTEX	1300							

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-131		17-SB-148 (Dup. 131)		17-SB-132		17-SB-133	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TOTAL BTEX: METHOD 8240 Toluene Ethylbenzene Total Xylenes						2400 5400	1200	2200
TOTAL BTEX						7800	1200	2200

NOTES:

Blank indicates compound was Not Detected

µg/kg indicates micrograms per kilogram.

Dup. indicates duplicate sample

J indicates analyte present. Reported value may not be accurate or precise.

TABLE 2-4 (CONTINUE...)

SOIL ANALYTICAL RESULTS
 TOTAL BTEX (BENZENE, TOLUENE, ETHYLBENZENE, AND TOTAL XYLENES)
 SITE 17 - FIRE FIGHTING AREA
 NAVAL AUXILIARY LANDING FIELD - FENTRESS
 FENTRESS, VIRGINIA
 APRIL 28 AND 29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-134		17-SB-135		17-SB-136		17-SB-137	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
TOTAL BTEX: METHOD 8240								
Toluene								
Ethylbenzene								
Total Xylenes								
TOTAL BTEX								

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-149 (Dup. 137)		17-SB-138		17-SB-139		17-SB-150 (Dup. 139)	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
TOTAL BTEX: METHOD 8240								
Toluene								
Ethylbenzene								
Total Xylenes								
TOTAL BTEX								

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-140		17-SB-141		17-SB-142		17-SB-143	
	01	02	01	02	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
TOTAL BTEX: METHOD 8240								
Toluene								
Ethylbenzene								
Total Xylenes								
TOTAL BTEX								

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-144		17-SB-145	
	01	02	01	02
	0 - 2	2 - 4	0 - 2	2 - 4
	Soil	Soil	Soil	Soil
TOTAL BTEX: METHOD 8240				
Toluene				
Ethylbenzene				
Total Xylenes				
TOTAL BTEX				

NOTES:

Blank indicates compound was Not Detected
 $\mu\text{g/kg}$ indicates micrograms per kilogram.
 Dup. indicates duplicate sample

**SUMMARY OF SOIL ANALYTICAL RESULTS
TCL VOLATILE ORGANIC COMPOUNDS
SITE 17 - FIREFIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28-29, 1993**

SOIL BORING LOCATION	17-SB-121	17-SB-122	17-SB-123	17-SB-124	17-SB-146 (Dup. 124)	17-SB-125	17-SB-126	17-SB-127	17-SB-128	17-SB-147 (Dup. 128)
SAMPLE NUMBER	03	03	02	02	02	01	02	01	01	01
SAMPLE DEPTH (FEET)	4 - 6	4 - 6	2 - 4	2 - 4	2 - 4	0 - 2	2 - 4	0 - 2	0 - 2	0 - 2
SAMPLE MATRIX	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
UNITS	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TCL VOLATILE ORGANIC COMPOUNDS: METHOD 8240										
Acetone								82 J	3 J	
2-Butanone										
Chlorobenzene			410 J							
Ethylbenzene										
Methylene Chloride	14							14		
Styrene										
Toluene	7 J		410 J					3 J	3 J	
Xylenes (Total)		1600 J	2600 J	2100 J	1000 J				39	

SOIL BORING LOCATION	17-SB-129	17-SB-130	17-SB-131	17-SB-148 (Dup. 131)	17-SB-132	17-SB-133	17-SB-134	17-SB-135	17-SB-136	17-SB-137
SAMPLE NUMBER	02	02	01	01	02	02	02	03	02	02
SAMPLE DEPTH (FEET)	2 - 4	2 - 4	0 - 2	0 - 2	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4
SAMPLE MATRIX	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
UNITS	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TCL VOLATILE ORGANIC COMPOUNDS: METHOD 8240										
Acetone										
2-Butanone					8 J					
Chlorobenzene					70					
Ethylbenzene							35			
Methylene Chloride				2 J					3 J	
Styrene					320					
Toluene		4 J	3 J		30		6 J	4 J	2 J	3 J
Xylenes (Total)						1200 J	190			

NOTES:

Blank indicates compound Not Detected

µg/kg indicates micrograms per kilogram

D after well number indicates deep well

J indicates analyte present. Reported value may not be accurate or precise.

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TABLE 2-- (CONTINUED)

**SUMMARY OF SOIL ANALYTICAL RESULTS
TCL VOLATILE ORGANIC COMPOUNDS
SITE 17 - FIREFIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28-29, 1993**

SOIL BORING LOCATION	17-SB-149 (Dup. 137)	17-SB-138	17-SB-139	17-SB-150 (Dup. 139)	17-SB-140	17-SB-141	17-SB-142	17-SB-143	17-SB-144	17-SB-145
SAMPLE NUMBER	02	02	02	02	02	02	02	02	02	02
SAMPLE DEPTH (FEET)	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4
SAMPLE MATRIX	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
UNITS	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
TCL VOLATILE ORGANIC COMPOUNDS: METHOD 8240										
Acetone										
2-Butanone										
Chlorobenzene										
Ethylbenzene										
Methylene Chloride									3 J	
Styrene										
Toluene			6 J	3 J		2 J		4 J	2 J	3 J
Xylenes (Total)		1200 J								

SOIL BORING LOCATION	TRIP BLANK-3	TRIP BLANK-4	TRIP BLANK-5	17-FB-01	17-SB-121 -ER
SAMPLE NUMBER					
SAMPLE DEPTH (FEET)					
SAMPLE MATRIX	Water	Water	Water	Water	Water
UNITS	µg/L	µg/L	µg/L	µg/L	µg/L
TCL VOLATILE ORGANIC COMPOUNDS: METHOD 8240					
Acetone					
2-Butanone					
Chlorobenzene					
Ethylbenzene					
Methylene Chloride					
Styrene					
Toluene					
Xylenes (Total)					

NOTES:

Blank indicates compound Not Detected

µg/L indicates micrograms per liter

ER indicates Equipment Rinsate sample

D after well number indicates deep well

J indicates analyte present. Reported value may not be accurate or precise.

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TABLE 2-6

SUMMARY OF SOIL ANALYTICAL RESULTS
TCL SEMI-VOLATILE ORGANIC COMPOUNDS
SITE 17 - FIRE FIGHTING TRAINING AREA
NAVAL AUXILIARY LANDING FIELD - FENTRESS
FENTRESS, VIRGINIA
APRIL 28-29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-121 03 4 - 6 Soil µg/kg	17-SB-122 03 4 - 6 Soil µg/kg	17-SB-123 02 2 - 4 Soil µg/kg	17-SB-124 02 2 - 4 Soil µg/kg
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene		1100 J	1100 J	
2-Methylnaphthalene		2900 J	3600 J	
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate				
Di-n-octylphthalate				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-146 (Dup. 124) 02 2 - 4 Soil µg/kg	17-SB-125 01 0 - 2 Soil µg/kg	17-SB-126 02 2 - 4 Soil µg/kg	17-SB-127 01 0 - 2 Soil µg/kg
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene	680 J			
2-Methylnaphthalene	2400 J			
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate		43 J		110
Di-n-octylphthalate				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-128 01 0 - 2 Soil µg/kg	17-SB-147 (Dup. 128) 01 0 - 2 Soil µg/kg	17-SB-129 02 2 - 4 Soil µg/kg	17-SB-130 02 2 - 4 Soil µg/kg
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene			72 J	
2-Methylnaphthalene				
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate	690 J	670 J	47 J	
Di-n-octylphthalate	750 J			
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-131 01 0 - 2 Soil µg/kg	17-SB-148 (Dup. 131) 01 0 - 2 Soil µg/kg	17-SB-132 02 2 - 4 Soil µg/kg	17-SB-133 02 2 - 4 Soil µg/kg
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene			42000	2300 J
2-Methylnaphthalene			89000	5700 J
Dibenzofuran			1900 J	
Di-n-butylphthalate		300 J		
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate	32 J	840 J	2100 J	
Di-n-octylphthalate		430 J		
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				

NOTES:

Blank indicates compound Not Detected

µg/kg indicates micrograms per kilogram

D after well number indicates deep well

J indicates analyte present. Reported value may not be accurate or precise.

TABLE 2-6 (CONTINUED)

SUMMARY OF SOIL ANALYTICAL RESULTS
 TCL SEMI-VOLATILE ORGANIC COMPOUNDS
 SITE 17 - FIRE FIGHTING TRAINING AREA
 NAVAL AUXILIARY LANDING FIELD - FENTRESS
 FENTRESS, VIRGINIA
 APRIL 28-29, 1993

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-134	17-SB-135	17-SB-136	17-SB-137
	02	03	02	02
	2 - 4	2 - 4	2 - 4	2 - 4
	Soil	Soil	Soil	Soil
UNITS	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene	2100 J			
2-Methylnaphthalene	6300 J			
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate	280 J		15 J	42 J
Di-n-octylphthalate				
Benzo(b)fluoranthene				41 J
Benzo(k)fluoranthene				54 J

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-149 (Dup. 137)	17-SB-138	17-SB-139	17-SB-150 (Dup. 139)
	02	02	02	02
	2 - 4	2 - 4	2 - 4	2 - 4
	Soil	Soil	Soil	Soil
UNITS	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene		330 J		
2-Methylnaphthalene		1900 J		45 J
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate	14 J	910 J		25 J
Di-n-octylphthalate		700 J		
Benzo(b)fluoranthene				30 J
Benzo(k)fluoranthene				39 J

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-140	17-SB-141	17-SB-142	17-SB-143
	02	02	02	02
	2 - 4	2 - 4	2 - 4	2 - 4
	Soil	Soil	Soil	Soil
UNITS	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$	$\mu\text{g/kg}$
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240				
Naphthalene				
2-Methylnaphthalene				
Dibenzofuran				
Di-n-butylphthalate				
Butylbenzylphthalate				
bis(2-ethylhexyl)phthalate	26 J			27 J
Di-n-octylphthalate				16 J
Benzo(b)fluoranthene				20 J
Benzo(k)fluoranthene				

SOIL BORING LOCATION SAMPLE NUMBER SAMPLE DEPTH (FEET) SAMPLE MATRIX UNITS	17-SB-144	17-SB-145
	02	02
	2 - 4	2 - 4
	Soil	Soil
UNITS	$\mu\text{g/kg}$	$\mu\text{g/kg}$
TCL SEMI-VOLATILE ORGANIC COMPOUNDS: METHOD 8240		
Naphthalene		
2-Methylnaphthalene		
Dibenzofuran		
Di-n-butylphthalate		
Butylbenzylphthalate		
bis(2-ethylhexyl)phthalate		
Di-n-octylphthalate		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		

NOTES:

Blank indicates compound Not Detected
 $\mu\text{g/kg}$ indicates micrograms per kilogram
 ER indicates Equipment Rinsate sample
 D after well number indicates deep well
 J indicates analyte present. Reported value may not be accurate or precise.

2.8 Site Conditions That Justify a Remediation

Previous investigations at Site 17 have confirmed the presence of TPHs in the vadose soils. During the final round of investigations, the analytical results of the soil sampling indicated that 29 of 49 samples contained concentrations of TPHs at or above 100 mg/kg, which is the Virginia "Guidelines for Disposal of Soils with Petroleum Products". Furthermore, the concentrations of TPHs in the vadose zone soils constitute a perpetual source for groundwater contamination and a possible threat to human health and the environment. Consequently, a removal action is highly recommended.

3.0 IDENTIFICATION OF REMOVAL OBJECTIVES

The objective of this removal action is to reduce the potential threat of constituents of concern to human health and the environment by addressing any sources of soil contamination at Site 17. The vadose zone soils on the northerly and westerly sides of the intersection of the concrete runways have been identified as sources of soil contamination. Therefore, the objective of this removal action is to address these areas of Site 17.

3.1 Statutory Limits on Removal Actions

The National Contingency Plan dictates statutory limits of \$2 million and 12 months on EPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the removal action to be taken. The removal action evaluated in this EE/CA will not be EPA fund-financed. Further, the removal action at Site 17 is not anticipated to require any exemptions on cost and schedule limits.

The Navy/Marine Corps IR Manual does not limit the cost or duration of the removal action; however, cost effectiveness is a recommended criterion for evaluation of removal action alternatives. This EE/CA will be prepared with respect to the cost effectiveness criterion.

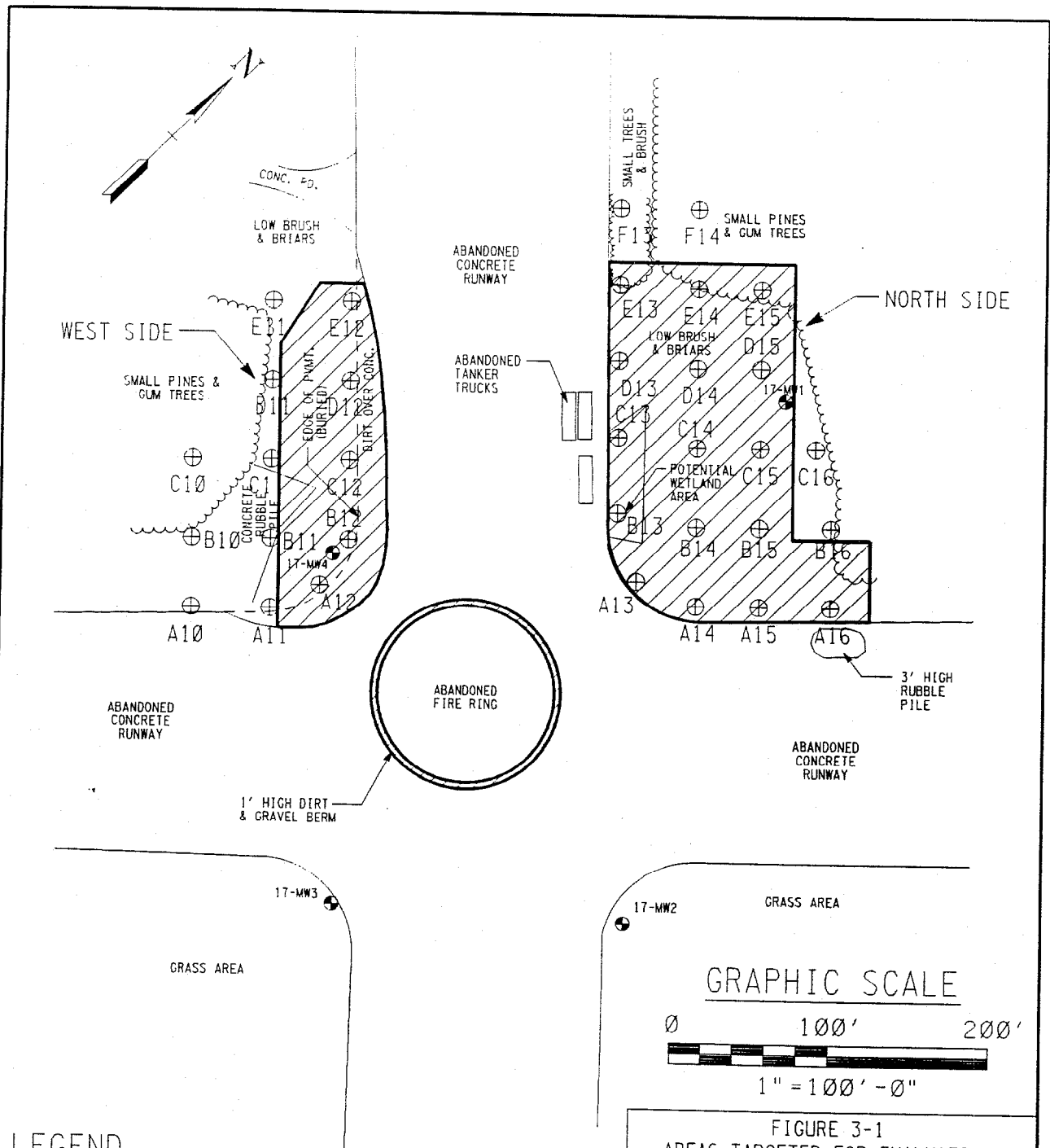
3.2 Removal Action Scope

The scope of this EE/CA, and consequently the removal action scope, is the vadose zone soils to the northerly and westerly sides of the intersection of the concrete runways at Site 17. Figure 3-1 depicts the areas targeted for evaluation of removal alternatives.

Specific items of work applicable to the eventual removal action vary with each removal alternative. An example of work items may include a combination of excavation of contaminated soils, storage, sampling, disposal or treatment of excavated materials, and post-construction restoration. Specific work items are elaborated in Section 5.0 where costs to implement each alternative are considered.

3.3 Removal Action Schedule

The removal action schedule to complete removal construction is within 12 months from the start date, which will be established by the time of approval of the Action Memorandum. Since this removal action has been designated as non-time-critical, the start date will be determined by factors other than the urgency of environmental risk posed



SOURCE: TARGET ENVIRONMENTAL, MAY 1993
SOIL GAS DATA NALF FENTRESS, VIRGINIA

FIGURE 3-1
AREAS TARGETED FOR EVALUATION
OF REMEDIAL ALTERNATIVES
SITE 17
FIREFIGHTING TRAINING AREA
FENTRESS, VIRGINIA

DRAWN BY: SAW 12/17/93 SCALE: 1"=100'-0"

FW

THIS DRAWING IS THE PROPERTY OF THE
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REV. 0 DATE: 03-01-94

esd166027:fig3-1.dgn FENT5.REF

by the constituents of concern. These factors include, but are not limited to, availability of resources, normal procurement periods, weather conditions, and other activities occurring at the site. Review and public comment periods will not affect the removal action time-frame, because these issues will be resolved prior to the release of the Action Memorandum.

A preliminary breakdown of the schedule is provided below:

- Action Memorandum: Day Zero
- Contract Award: Day 30
- * Contract Completion: Day 120 to 360

(* Contract Completion will vary depending on the selected removal alternative.)

3.4 Applicable or Relevant Appropriate Requirements (ARARs)

The 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP), while not requiring that removal actions attain applicable or relevant and appropriate Federal and State requirements, recommends that to the extent practicable they be attained. These guidelines, which are known as ARARs for the site, may be specific to the conditions present on the site or may be meant to address similar situations and, therefore, are suitable for use at the site.

The Department of the Navy, which is the lead agency for this site, has determined the federal ARARs for this removal action and listed the proposed state ARARs. USEPA will play a major role in reviewing the federal ARARs for the Removal Action. The Virginia Department of Environmental Quality will confirm the identification of state ARARs and provide additional ARARs, if necessary.

Three factors are applied to determine whether the identification and attainment of ARARs is practicable in a particular removal situation: (1) the demands of the situation; (2) the effect of ARAR attainment on the statutory limits for removal action duration and cost; and (3) the criteria listed under SARA section 121(d)4 providing conditions under which ARARs may be waived. The first two factors do not apply to this action. This EE/CA by definition is for a non-time-critical removal action, and as such, urgent conditions do not constrain or preclude efforts to attain ARARs. Statutory limits on removal time and cost are not applicable for removal actions not funded by the EPA or State. Therefore the attainment of ARARs should not be affected by the demands of the situation or by the statutory limit in the scope of the removal action.

The criteria listed under SARA section 121(d)4 for which ARARs may be waived include the following:

- Interim remedy waiver
- Greater risk to health and the environment
- Technical impracticability
- Equivalent standard of performance
- Inconsistent application of State requirements

The analysis of removal alternatives will determine if all ARARs can be attained at a site and if the action qualifies for an exception under SARA. If all ARARs cannot be attained, the removal action will be evaluated against those ARARs which are most crucial to the proper stabilization of the site and to the proper protection of public health and the environment until removal action can provide additional protection.

ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are particular to individual contaminants. Location-specific ARARs depend upon the location of the contamination and potential restrictions on activities conducted in these areas (i.e., wetlands, floodplains, etc.) Action-specific ARARs, as the name implies, govern the removal actions. Action-specific ARARs are usually technology- or activity-based directions or limitations that control actions taken at CERCLA sites.

The following sections present the ARARs which must be attained or considered as part of the removal action scope at Site 17. Included are the recommended clean up goals for contaminated soils.

3.4.1 Chemical-Specific ARARs

- Site Specific Cleanup Goals for Soil - The contaminant cleanup levels listed below, have been developed to assure remediation of all contaminated soil to levels which do not pose a health risk due to direct contact with the soil in an industrial setting. These levels have been established by the Commonwealth of Virginia Department of Waste Management "Guidelines for the Disposal of Soil Contaminated with Petroleum Products", dated January 5, 1991. Confirmation samples taken after excavation of contaminated soil and debris must be lower than these levels for the remediation to be considered complete.

Chemical of ConcernCleanup Goal for Industrial Soil (mg/kg)

Total Petroleum Hydrocarbons

100

- Identification and Listing of Hazardous Waste - The criteria for identifying the characteristics of hazardous waste and for listed hazardous wastes are provided in RCRA, 40 CFR Part 261 and Virginia Waste Management Regulations VR 672-10-1. Any wastes found to be RCRA hazardous wastes will be stored, treated and/or disposed according to the applicable regulations in these sections.

This removal action will not address groundwater contamination as stated in Section 3.2. Surface waters will not be impacted.

Air emissions are not expected to be a concern during these removal activities, unless an on-site treatment alternative is selected. The following standards regulate the air emissions resulting from such activities:

- National Ambient Air Quality Standards - The Clean Air act gives the criteria and requirements for ambient air quality monitoring and the requirements for reporting ambient air quality data and information. Virginia DEQ has been delegated authority to implement these standards using Virginia Air Pollution Control Regulations. Based on these regulations, air at and around Site 17 be monitored to ensure compliance with these standards.

3.4.2 Location-Specific ARARs

- Endangered Species Act (16 USC 153) - The Endangered Species Act requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modifications to their habitat. There are no endangered species observed at the site in the area targeted for removal action.
- National Historic Preservation Act - It is believed that there are no buildings listed on the National Register of Historic Places at Site 17. The Virginia Office of Historic Places can be contacted to obtain a list of Historic Places to determine and identify any historic landmarks/places in the general area of the site.

3.4.3 Action-Specific ARARs

The following action specific ARARs are relevant to the planned removal activities:

1. Land Disturbing Activities are regulated under the Virginia Stormwater Management Act, Sec. 10.1-603.1 et seq.; Virginia Stormwater Management Regulations (VR 215-02-00), the Virginia Erosion and Sediment Control Law, Code of Virginia 10.1-560 et seq., the Virginia Erosion and Sediment Control Regulations (VR 625-02-00), as well as local stormwater management and sediment and erosion control programs administered by the County Design. Plans concerning these activities will be submitted by the DEQ-Waste Division to LANTDIV for review before any land-disturbing activity.

The following regulations should be referenced on an as-needed basis during the removal action:

- RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264) - This regulation plays a role in determining the final destination of the excavated soils or other disposal materials from the site. 40 CFR Part 264 regulates the treatment, storage and disposal of hazardous waste. It will be determined which chemicals found on site are RCRA listed or characteristic hazardous wastes. If RCRA hazardous wastes are found to be present on site, all applicable rules and regulations as stated in 40 CFR Part 264 will be followed and the appropriate coordination will be obtained.
- RCRA Land Disposal Restrictions (40 CFR 268) - 40 CFR Part 268 identifies those RCRA hazardous wastes that are restricted from land disposal. Waste that is land disposal restricted would be shipped off site for disposal with the proper labels, manifests, and notification forms indicating that the waste is land disposal restricted.
- OSHA (29 CFR 1910, 1926, 1940) - These regulations provide occupational safety and health requirements applicable to workers engaged in on site field activities. It is required that the regulations be followed for site workers during construction and operation of removal activities. Therefore, all workers will be made aware of the regulations and they will be enforced by the Site Health and Safety Officer during all removal activities.
- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1 - 171.500) -The wastes from the removal activities will be classified for transportation based on the chemicals present in the material.

Shipping papers (including hazardous waste manifests) will be prepared that describe the hazardous material offered for transportation and will include contents, shipper's name, proper shipping name, hazard class, identification number, total quantity, and certification that the material is presented according to DOT regulations. All wastes will be packaged according to DOT regulations with the proper markings on each container.

3.5 Disposal Requirements

If the proposed removal action entails off-site disposal of materials, the following action-specific ARARs are applicable:

1. Excavation/Offsite Disposal of Soils is regulated under Virginia Waste Management Act, Code of Virginia Sections 10.1-1400 et seq.; Virginia Hazardous Waste Management Regulations (VHWMR) (VR 672-10-1); Virginia Solid Waste Management Regulations (VSWMR) (VR 672-20-10), as well as the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901, and the applicable regulations contained in Title 40 of the Code of Federal Regulations; and the U. S. Department of Transportation Rules for Transportation of Hazardous Materials, 49 CFR Parts 107, 171.1-172.558.
 - a. If the removal response contemplated involves storage, treatment or disposal of a VHWMR/RCRA hazardous waste, various VHWMR/RCRA requirements may need to be complied with as specified in VHWMR and/or the applicable 40 CFR Parts. Because Virginia administers an authorized state RCRA program, the Virginia Hazardous Waste Management Regulations (VHWMR) will serve as the governing ARAR in place of the RCRA regulations contained in the 40 CFR Parts, except for the Land Disposal Restrictions of 40 CFR Part 268.
 - b. The transportation of hazardous waste must be conducted in compliance with VHWMR (VR 672-10-1) Part V (Manifest Regulations for Hazardous Waste Management), and Part VII (Regulations Applicable to Transporters of Hazardous Waste), VHWMR (VR 672-30-1) Regulations Governing the Transportation of Hazardous Materials, and 49 CFR Parts 107, 171.1-172.558.
 - c. The deposits of any soil, debris, sludge or any other solid waste from a site must be done in compliance with VSWMR (VR 672-20-10). Contaminated material from the site that is not

classified as hazardous may be classified as a special waste under Part VIII of VSWMR. Specific authorization from VDWM is required before a landfill operator in Virginia can accept special wastes.

In addition to these disposal requirements, those action-specific ARARs applicable to the proposed removal action specified as "to be referenced on an as-needed basis" may be applicable (see Section 3.4).

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The following section presents a discussion of removal action alternatives applicable to Site 17. Five alternatives are synopsized to address the removal action objectives identified in Section 3.0. These alternatives are analyzed in detail in Section 5.0.

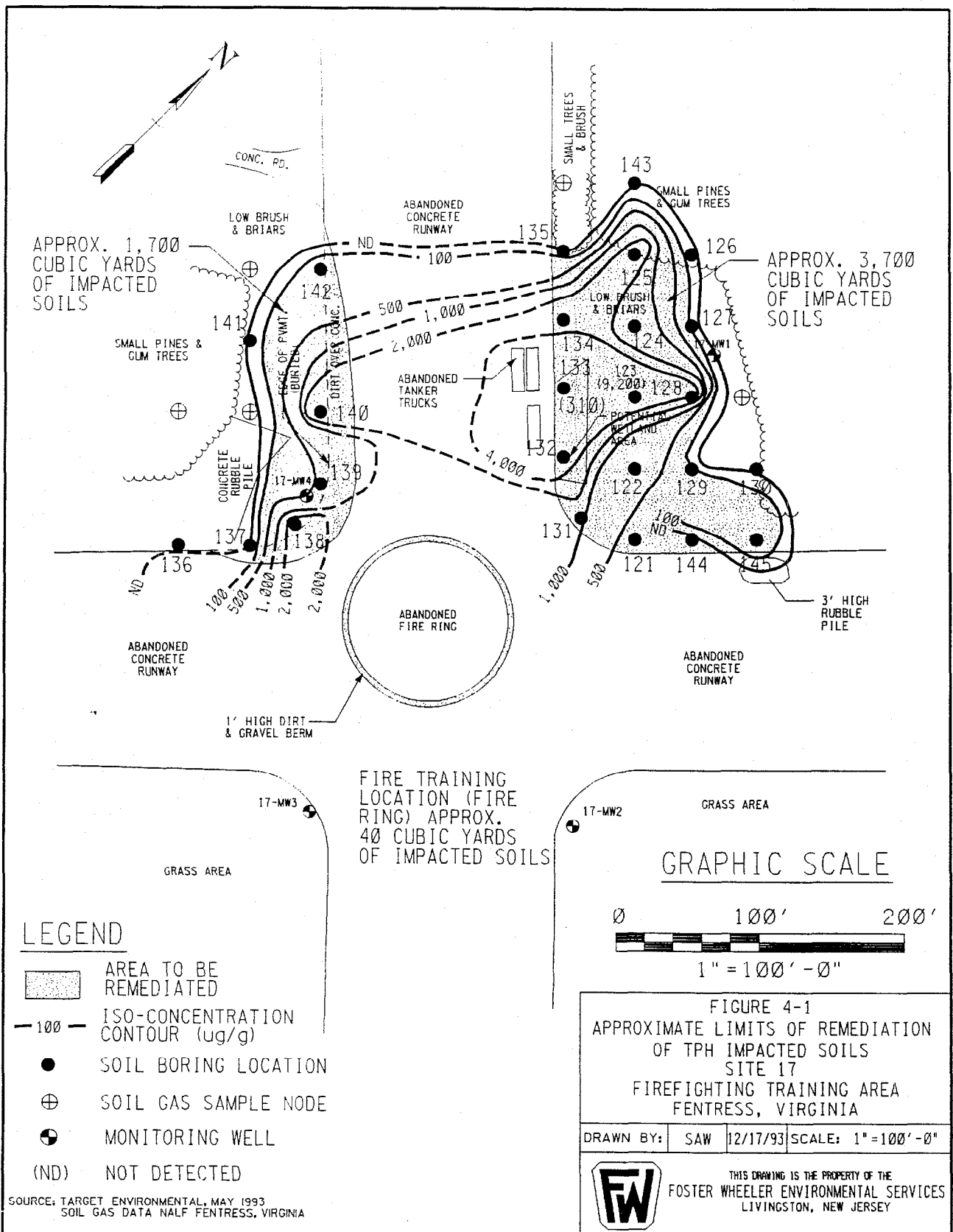
Alternative 1 consists of Institutional Controls and does not involve any active remediation. General work items which are common to alternatives 2 through 5 include the following:

- 1) Delineation and possible mitigation of wetlands;
- 2) Consolidation of portions of a rubble pile which impact removal activities;
- 3) Abandonment of monitoring wells 17-MW1 and 17-MW4. These two monitoring wells will be impossible to avoid during removal activities and as such, cannot be left intact;
- 4) Post-removal confirmatory sampling and analysis;
- 5) Remediation of approximately 40 cubic yards of soil associated with the fire ring, located in the center of the intersection of the two concrete runways. This volume is calculated as 1,085 square foot surface area multiplied by an average of 1 foot deep;
- 6) Remediation of approximately 3,700 cubic yards of soil on the north side of the runway. This volume is calculated as 25,000 square foot surface area multiplied by an average of 4 feet deep;
- 7) Remediation of approximately 1,700 cubic yards of soil on the west side of the runway. This volume is calculated as 11,700 square foot surface area multiplied by an average of 4 feet deep; and,
- 8) Dewatering of standing water prior to excavation. It is especially critical for offsite alternatives that soils to be removed contain less than 50% moisture by weight, otherwise waste will not be accepted by most disposal facilities. Optimum moisture content of such soils is 30% or less. Standing water should be discharged to the surface at a location near the work area, but out of the way of removal activities. Construction specifications prepared for the removal action should direct the contractor to be responsible for any accumulated water in open excavations during remediation.

The concrete runways will not be excavated as part of this removal action. The concrete runways may function as an impermeable surface water barrier to the underlying soils and groundwater. This is evidential since the groundwater has not been impacted. The shaded areas on Figure 4-1 depict quantities and areas to be remediated.

Other items of work not included are as follows:

- 1) Relocation of abandoned tanker trucks, if necessary to implement removal action;
- 2) Removal of surface debris within the fire ring, if any; and,
- 3) Disposal of rubble pile and debris.



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4.1 Alternative 1: Institutional Controls

Institutional controls - such as the implementation of a quarterly groundwater monitoring program, construction of a fence around contaminated areas to restrict access, or other restrictions to use of the contaminated areas - are non-engineering solutions imposed to prevent unregulated access to the site or movement of contaminated media. This alternative would entail the preparation of administrative mandates such as deed restrictions. It would also include implementation of a monitoring well sampling and analysis program.

4.2 Alternative 2: On-Site Treatment - Thermal

On-site treatment utilizing a mobil, thermal treatment unit was identified as a potential alternative because of the volume of soil which requires remediation. Implementation of this alternative entails excavation of the contaminated soils, processing of the soils through the thermal treatment unit, and backfilling of treated soils. The soils to be backfilled would require verification testing to ascertain that these soils do not contain constituents of concern at concentrations above allowable levels for material classified as suitable backfill.

4.3 Alternative 3: On-Site Treatment - Bioremediation

On-site treatment utilizing a truck-mounted, biotreatment unit was identified as a potential alternative because of the volume of soil and nature of constituents which requires remediation. Implementation of this alternative entails excavation of the contaminated soils, processing of the soils through the biotreatment unit, and backfilling of treated soils. The soils to be backfilled would require verification testing to ascertain that these soils do not contain constituents of concern at concentrations above allowable levels for material classified as suitable backfill.

4.4 Alternative 4: Off-Site Disposal - Landfill

Off-site disposal at a RCRA-approved landfill was identified as a potential alternative because of the nature of constituents and expectation that this alternative will provide an effective method of remediation. Implementation of this alternative entails excavation of the contaminated soils, transportation of the soils to an offsite landfill, and backfilling of excavated areas with suitable soils. The soils to be backfilled would require certification, by the contractor supplying backfill materials, that these soils do not contain constituents of concern at concentrations above allowable levels.

4.5 Alternative 5: Off-Site Disposal - Incineration

Off-site disposal at a RCRA-approved incinerator was identified as a potential alternative because of the nature of constituents and expectation that this alternative will provide an effective method of remediation. Implementation of this alternative entails excavation of the contaminated soils, transportation of the soils to an offsite incinerator, and backfilling of excavated areas with suitable soils. The soils to be backfilled would require certification, by the contractor supplying backfill materials, that these soils do not contain constituents of concern at concentrations above allowable levels.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents an analysis of the five removal alternatives discussed in Section 4.0. The analysis is conducted to develop a comparative basis for each alternative. Each alternative will be analyzed based on the criteria cited in the EPA Guidance for EE/CA, dated August, 1993. These criteria are:

- Effectiveness, an alternative's ability to meet the objective within the scope of the removal action;
- Implementability, an alternative's ability to be implemented technically, administratively, and resourcefully; and,
- Costs to Implement.

The Navy/Marine Corps IR Manual, which parallels the EPA Guidance for Non-Time Critical Removal Actions, recommends that criteria for evaluation of removal alternatives include the following criteria:

- Effectiveness to minimize the threat to public health;
- Consistency with anticipated final removal action;
- Consistency with ARARs, and;
- Cost effectiveness.

Together, these criteria will be utilized for analysis of the removal alternatives.

In addition to items of work which are unique to each alternative, at least two site conditions must be addressed prior to or during implementation of alternatives 2 through 5. These items are presented as a preface to the discussion of alternatives, as follows:

- (1) An apparent wetlands exists on the northerly side of the site immediately adjacent to the concrete runway, extending several feet into the area impacted by constituents of concern. These potential wetlands should be definitively delineated prior to commencement of any intrusive site work which will result in large-scale disturbance. If it is determined that the apparent wetlands indeed qualify as wetlands, an impact analysis should be conducted to determine possible options for removal activities in these areas.
- (2) A large rubble pile, consisting of large chunks of concrete, exists on the westerly side of the site. This rubble pile protrudes approximately twenty feet into the area impacted by constituents of concern. That portion of the rubble pile which will potentially impact the implementation of the removal action should be extracted from the areas to be remediated and immediately adjacent to these areas, and pulled back into the main portion of the rubble pile. It is estimated that the quantity of the rubble pile which will be impacted by removal activities is approximately 100 square feet by 3 feet deep (11 cubic yards).

5.1 Alternative 1: Institutional Controls

Implementation of this alternative would entail the following general items of work:

- (1) Preparation of mandate restricting use of the site.
- (2) Preparation of mandate prohibiting intrusive activities into the site soils.
- (3) Implementation of a long-term groundwater monitoring program, using the 4 existing monitoring wells located at Site 17. Long-term is assumed to be 30 years for this EE/CA.
- (4) Preparation of annual reports which assess the site conditions based on results of groundwater monitoring, including a potential recommendation for removal action if groundwater monitoring indicates an impact to the groundwater.

5.1.1 Effectiveness

Protectiveness : Since constituents of concern have been found in the soils and not in the groundwater, it is apparent that the soils have retained the constituents of concern. If the prohibition against conducting intrusive activities at the site is upheld, the impacted soils may not pose a risk to human health and the environment. However, if constituents of concern are left in the soils, it's possible that the soils will eventually contaminate the groundwater and may pose a risk to human health and wildlife. Although a groundwater monitoring program will signal if groundwater is contaminated, it will not directly protect the groundwater.

This alternative will not be effective in attaining the chemical-specific ARARs since impacted soils would remain in-place.

Use of Alternatives to Land Disposal : This evaluation criteria is not applicable to this alternative.

5.1.2 Implementability

Technical Feasibility : The implementation of a sampling and analysis (groundwater monitoring) program is routine and feasible. The preparation of annual reports is also routine and feasible.

Availability : Equipment, materials, and laborers (EM&L) to implement this alternative are readily available.

Administrative Feasibility : The implementation of this alternative would not require permitting; however, the preparation and enforcement of institutional mandates may be difficult or impossible. Also, the likelihood of

public, state, and federal acceptance is low. The schedule to implement this alternative would be contingent on the efficiency of administrative procedures.

5.1.3 Costs

Total costs to implement this alternative are \$43,312. Details of these costs are presented in Table 5-1.

5.2 Alternative 2: On-Site Treatment - Thermal

Implementation of this alternative would entail the following items of work:

- (1) Implementation of logistical plan to abet construction.
- (2) Procurement of all necessary permits to begin construction. Necessary permits may include: state or county erosion and sedimentation control permit; wetlands permit; local earthwork permit. In addition to these permits, additional permitting must be undertaken before federal approval of the treatment method is accepted. These permits are related to regulations governed under the Resource Conservation and Recovery Act (RCRA) and ensure the adequate protection of air, environmental surroundings, and personnel involved in the work.
- (3) Site preparation, such as: clearing and stockpiling of rubble pile; removal of standing water; clearing and grubbing of surface to be excavated; installation of erosion and sedimentation control structures.
- (4) Excavation of approximately 5,440 cubic yards of impacted soils. This quantity consists of 3,700 cubic yards from the north side of the runway, 1,700 cubic yards from the west side of the runway, and 40 cubic yards from the former firefighting training fire ring.
- (5) Post-Excavation verification of excavated areas by sampling and analysis. Frequency of post-excavation soil sampling should be similar to that used during the site investigation. This requires samples to be collected at the depth of the excavation on 50-foot centers. At this frequency, it is estimated that 20-30 post-excavation samples will be required. Analysis of the samples should be for TPHs. Items 3-5 would be repeated if post-excavation sampling and analysis dictates that more soil should be remediated.
- (6) Mobilization and treatment of soils by processing through the on-site thermal treatment unit. The thermal treatment will take advantage of the combustive properties of TPHs; therefore, thermal destruction of these constituents is envisioned. Processed and treated soils will be staged for immediate post-treatment verification.
- (7) Post-treatment verification of treated soils by composite sampling and analysis. Frequency of post-treated soil sampling cannot be determined at this time, since this program will be dictated by the conditions established in the on-site treatment permit. It is anticipated that one composite sample may be required for each 100 cubic yards of material treated. Using this frequency as a baseline estimate, approximately 54 samples will be required to certify the material as clean backfill.
- (8) Backfilling and regrading with approximately 7,000 cubic yards of clean, certified backfill material. The increase in volume of soil required to restore the original surface grade accounts for compaction. Of this

TABLE 5-1

COST BREAKDOWN
ALTERNATIVE 1 – INSTITUTIONAL CONTROLS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DIRECT COSTS				
Deed Restrictions	1	allowance	\$5,000.00	\$5,000
* Groundwater Sampling	30	year	\$4,000.00	\$7,812
* Groundwater Analysis	30	year	\$800.00	\$1,562
TOTAL DIRECT COSTS				\$14,374
INDIRECT COSTS				
Engineering/Design	1	allowance	\$25,000.00	\$25,000
TOTAL INDIRECT COSTS				\$25,000
SUBTOTAL				\$39,374
Contingency (10%)				\$3,937
* TOTAL ESTIMATED COST				\$43,312

* Yearly costs related to implementation of monitoring well program have been converted to Net Present Value, based on an annual discount rate of 5% for 30 years

7,000 cubic yards, it is anticipated that approximately 4,300 cubic yards can be recovered from the treatment unit for use as backfill. The additional 1,140 cubic yards must be provided from an off-site borrow source.

- (9) Demobilization of the on-site thermal treatment unit.
- (10) Restoration in-kind of original site features, such as wetlands (if required), ground cover, and other vegetation.
- (11) After completion of all of the activities associated with this removal action, a report will be prepared documenting the results.

5.2.1 Effectiveness

Protectiveness : This alternative is very effective in eliminating risks to human health and the environment posed by the site. Excavation ensures that most or all of the impacted soils will be removed from the environment. On-site thermal treatment is a highly effective method of destroying the contaminants in the site soils, due to the combustive properties of the constituents of concern, providing nearly 100% effectiveness in reducing contaminant concentrations below levels of concern. All ARARs would potentially be met by implementing this method. The long-term protectiveness of this alternative is high.

The short-term protectiveness of this alternative is low. The risk of dermal contact with constituents of concern as a result of excavating the site soils is imminent; however, the constituents of concern are not highly dangerous to human health. Additionally, the risk of injury during operation of the treatment system is high due to the torrid temperatures and potential air emissions which will be encountered by workers.

Use of Alternatives to Land Disposal : This alternative is very effective as an alternative to land disposal. First, because this alternative will generate clean material, there will be no need to "dispose" of the soils at a landfill. Second, since this alternative is conducted onsite, backfilling is simplified. A borrow source would not be necessary, except for providing nominal backfill materials to account for compaction of soils processed through treatment.

5.2.2 Implementability

Technical Feasibility :

The technical feasibility of this alternative is moderate, compared with other alternatives. Excavation of the site soils is manageable due to the level terrain and ease of accessibility at the site; however, precautions will have to

be taken to avoid creating adverse working conditions. Such conditions may include: unwanted creation of wastewater due to pooling of rainwater in open excavations; erosion and sedimentation by wind or runoff created after the denuding of ground surfaces; and destruction of established vegetation, such as large trees.

On-site thermal treatment, although more difficult than utilizing an off-site incinerator, is a proven and common procedure. Advances in mobil treatment units have rendered thermal treatment possible even for non-combustible contaminants. This alternative is designed to meet ARARs, particularly a SARA requirement that the removal actions should contribute to the efficient performance of long-term removal actions.

Availability : EM&L to implement the excavation portion of this alternative are readily available. EM&L to implement the treatment portion of this alternative may be less readily available, because the treatment method represents a limited resource. For example, specialty skills are required to operate the treatment system.

Administrative Feasibility : The implementation of this alternative may require special permits because of the treatment option. Consequentially, the administrative feasibility for this alternative is moderate to low. The likelihood of public and state acceptance of this alternative is moderate to high, contingent upon federal acceptance and implementation of informative public awareness sessions.

5.2.3 Costs

Total costs to implement this alternative are \$620,351. Details of these costs are presented in Table 5-2.

5.3 Alternative 3: On-Site Treatment - Bioremediation

Excavation of approximately 5,440 cubic yards of impacted soils. This quantity consists of 3,700 cubic yards from the north side of the runway, 1,700 cubic yards from the west side of the runway, and 40 cubic yards from the former firefighting training fire ring.

Implementation of this alternative would consist of the following items of work:

- (1) Implementation of logistical plan to abet construction.
- (2) Soil samples will be collected from the site soils to be analyzed for soil fertility, micronutrients, and bacterial identification as a treatability test. These analyses will assess the feasibility of bioremediation and assist the design of the bioremediation program by identifying the soil amendments necessary for the

TABLE 5-2

COST BREAKDOWN
ALTERNATIVE 2 – ON SITE TREATMENT (THERMAL)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DIRECT COSTS				
Excavation	5,440	cubic yds	\$4.00	\$21,760
Thermal Treatment	5,440	cubic yds	\$40.00	\$217,600
Clean Fill	1,140	cubic yds	\$8.25	\$9,405
Sampling and Analysis (Post-Ex)	30	each	\$55.00	\$1,650
Sampling/Analysis (post-treatment)	54	each	\$55.00	\$2,970
Site Work (Grading, Restoration)	37,785	square ft	\$2.00	\$75,570
Erosion and Sedimentation Control	1	allowance	\$20,000.00	\$20,000
TOTAL DIRECT COSTS				\$348,955
INDIRECT COSTS				
Engineering/Design	1	allowance	\$80,000.00	\$80,000
Construction Misc.	9	months	\$15,000.00	\$135,000
TOTAL INDIRECT COSTS				\$215,000
SUBTOTAL				\$563,955
Contingency (10%)				\$56,396
TOTAL ESTIMATED COST				\$620,351

successful bioremediation of the soils. For cost estimation purposes, it is assumed that four samples will be collected for such analyses.

- (3) Two composite soil samples will also be analyzed for TCLP metals. The heavy metals are toxic to the microbial activity and therefore inhibit bioremediation.
- (4) Procurement of all necessary permits to begin construction. Necessary permits may include: state or county erosion and sedimentation control permit; wetlands permit; local earthwork permit. In addition to these permits, additional permitting must be undertaken before federal approval of the treatment method is accepted. These permits are related to regulations governed under RCRA and ensure the adequate protection of environmental surroundings and personnel involved in the work.
- (5) Once the sampling results are available and permitting is in-place, a suitable area of the site will be selected for conducting removal activities. This area will be cleared of any brush, and a portable biotreatment cell will be mobilized at the site. The area of the cell will be approximately 15,000 square feet which will enable the loads of contaminated soil (approximately 1,100 cubic yards per load) to be staged in a two feet thick layer.
- (6) Excavation of approximately 5,440 cubic yards of impacted soils. This quantity consists of 3,700 cubic yards from the north side of the runway, 1,700 cubic yards from the west side of the runway, and 40 cubic yards from the former firefighting training fire ring. The excavated soils will be staged in the biotreatment cell. Excavation will be conducted in stages to coincide with treatment stages.
- (7) The first 1,100 cubic yard excavation will immediately be backfilled with a clean borrow material, imported from a nearby borrow source. Subsequent excavations will immediately be backfilled using soils treated from the preceding stage. In this manner, borrow needs for this alternative will include only enough material to backfill the first excavation, plus the amount required to meet compaction specifications.
- (8) Soil amendments such as sawdust and fertilizers will be added to the cell to achieve optimum biodegradation rates. The soils will be irrigated on a regular basis. Periodic tilling will also be necessary to ensure proper aeration and mixing.
- (9) Four surface soil samples will be collected monthly until the TPH levels in the soils reach the regulated level of 100 ppm. It is estimated that the bioremediation will continue for a period of one year. The soil samples will be analyzed for TPH as well as soil fertility and micronutrients. The monitoring will determine the levels of amendments added in the subsequent periods.
- (10) Once required TPH levels are attained within the soils, the soils will be backfilled within the original excavations, and the portable biotreatment cell will be decontaminated and demobilized from the site. It is estimated that approximately 5,000 cubic yards of treated soils will be used as backfill. The estimated total requirement for clean borrow material, to be imported from a nearby borrow source, is 3,100 cubic yards.
- (11) After completion of all of the activities associated with this removal action, a report will be prepared documenting the results.

5.3.1 Effectiveness

Protectiveness: This alternative permanently eliminates the risk of release of TPH contaminants into the

environment. The risk reduction by biotreatment has been demonstrated to be reliable in the long-term. However, residual risks exist due to soils which will not be excavated. In addition, short-term risks to site workers and the nearby community will continue to exist for an approximate period of one year. The performance of this alternative will ensure compliance with the chemical-specific, location-specific, and action-specific ARARs.

The total duration of the on-site activities is expected to be no more than one year and conform to the schedule shown in Section 3.3.

Use of Alternatives to Land Disposal: This alternative is very effective as an alternative to land disposal. First, because this alternative will generate clean material, there will be no need to "dispose" of the soils at a landfill. Second, since this alternative is conducted onsite, backfilling is simplified. A borrow source would not be necessary, except for providing nominal backfill materials to account for compaction and the first excavation of soils processed through treatment.

5.3.2 Implementability

Technical Feasibility: Bioremediation of TPH contaminated soils has been performed at many sites nationwide during the last five years. The Baker Team has completed one such project for U.S. Navy at Craney Island and will perform another one at Yorktown Fuels Depot. Therefore, this technology is considered feasible. Related sampling and analysis techniques, as well as excavation procedures are routine and feasible. This alternative meets ARARs, particularly a SARA requirement that the removal actions should contribute to the efficient performance of long-term removal actions.

One disadvantage to the technical feasibility of this alternative is associated with the length of time required for treatment. This fact raises a difficulty with how to handle an open excavation during treatment. Since approximately 15,000 square feet of area will be excavated during a given treatment stage, a method of preventing the accumulation of rainwater in the excavation must be contrived. A recommended solution to this dilemma would involve construction sequencing such that only one stage of off-site borrow material would be necessary. The off-site borrow material would be used as backfill for the first excavation. Succeeding excavations would be backfilled with treated material from the bio-unit.

Availability: EM&L to implement this alternative are readily available. Specialty subcontractors for laboratory analysis and biotreatment cell operation are known to the Baker Team. Availability of a proper staging area for the removed waste should be checked with the base personnel.

Administrative Feasibility: The implementation of this alternative may require permits for on-site treatment activities. No transportation permits will be required. Likelihood of public and state acceptance of this alternative is moderate to high.

5.3.3 Costs

Total costs to implement this alternative are \$564,878. Details of the costs are shown in Table 5-3.

5.4 Alternative 4: Off-Site Disposal - Landfill

This alternative consists of the following items of work:

- (1) Implementation of logistical plan to abet construction.
- (2) Procurement of all necessary permits to begin construction. Necessary permits may include: state or county erosion and sedimentation control permit; wetlands permit; local earthwork permit; local or state transportation permit; disposal facility permit.
- (3) Site preparation, such as: clearing and stockpiling of rubble pile; removal of standing water; clearing and grubbing of surface to be excavated; installation of erosion and sedimentation control structures.
- (4) Excavation, transportation, and disposal of approximately 5,440 cubic yards of impacted soils to an approved landfill. This quantity consists of 3,700 cubic yards from the north side of the runway, 1,700 cubic yards from the west side of the runway, and 40 cubic yards from the former firefighting training fire ring.
- (5) Post-Excavation verification by sampling and analysis. Frequency of post-excavation soil sampling should be similar to that used during the site investigation. This requires samples to be collected at the depth of the excavation on 50-foot centers. At this frequency, it is estimated that 20-30 post-excavation samples will be required. Analysis of the samples should be for TPHs. Items 3-5 would be repeated if post-excavation sampling and analysis dictates that more soil should be remediated.
- (6) Backfilling and regrading with approximately 7,000 cubic yards of clean, certified backfill material. The increase in volume of soil required to restore the original surface grade accounts for compaction.
- (7) Restoration in-kind of original site features, such as wetlands (if required), ground cover, and other vegetation.
- (8) After completion of all of the activities associated with this removal action, a report will be prepared documenting the results.

5.4.1 Effectiveness

Protectiveness: Removal and off-site disposal of contaminated material from Site 17 will mitigate the risk of releases of contamination to the groundwater and other areas. The petroleum hydrocarbons contaminated soils would be removed, thereby eliminating current and potential sources of groundwater contamination.

This alternative ensures long-term protection of the environment since it is permanent in nature. Compliance with all chemical-specific and location-specific ARARs is expected. Confirmatory samples would further ensure compliance with chemical-specific ARARs. On-site activities and off-site transport and disposal would comply with all action-specific ARARs. Short-term impact on the health of the site workers will be mitigated by using appropriate measures as dust control and containment of excavated waste.

Use of Alternatives to Land Disposal: This alternative does not employ an alternative to land disposal.

5.4.2 Implementability

Technical Feasibility: Excavation and removal of soils up to 4 feet is a demonstrated and commercially available technology nationwide. Excavation of site soils is manageable due to the level terrain and ease of accessibility at the site. Sampling and analysis techniques are routine and feasible. All ARARs will be met by implementing this alternative.

Availability: Equipment, materials, and personnel to implement this alternative are readily available. Availability of a proper staging area for the excavated soils should be checked with the base personnel, since they will be kept on-site during the pre-disposal analysis. Availability of disposal facilities is not expected to be a concern. There are several landfills that accept this waste type within 100 miles of Site 17.

Administrative Feasibility: The implementations of this alternative does not require any permits for on-site activities based on exemptions granted under CERCLA 121(e). It will be ensured that the disposal facilities have the appropriate permits. Transportation would be performed by licensed hazardous waste haulers. As with any off-site alternative, material loads being removed from the site would require transportation manifests and waste profiles. The likelihood of public and state acceptance of this alternative is moderate.

5.4.3 Costs

Total costs to implement this alternative are \$1,000,483. Details of the costs are shown in Table 5-4.

5.5 Alternative 5: Off-Site Disposal - Incineration

Implementation of this alternative would entail identical items of work as Alternative 4, with the exception of the disposal method, as follows:

- (1) Implementation of logistical plan to abet construction.
- (2) Procurement of all necessary permits to begin construction. Necessary permits may include: state or county erosion and sedimentation control permit; wetlands permit; local earthwork permit; local or state transportation permit; disposal facility permit.
- (3) Site preparation, such as: clearing and stockpiling of rubble pile; removal of standing or ponded water; clearing and grubbing of surface to be excavated; installation of erosion and sedimentation control structures.
- (4) Excavation, transportation, and disposal of approximately 5,440 cubic yards of impacted soils to an approved incinerator. Either low temperature desorption or high temperature incineration may be used, depending on the TSD selected. This quantity consists of 3,700 cubic yards from the north side of the runway, 1,700 cubic yards from the west side of the runway, and 40 cubic yards from the former firefighting training fire ring.
- (5) Post-Excavation verification by sampling and analysis. Frequency of post-excavation soil sampling should be similar to that used during the site investigation. This requires samples to be collected at the depth of the excavation on 50-foot centers. At this frequency, it is estimated that 20-30 post-excavation samples will be required. Analysis of the samples should be for TPHs. Items 1-5 would be repeated if post-excavation sampling and analysis dictates that more soil should be remediated.
- (6) Backfilling and regrading with approximately 7,000 cubic yards of clean, certified backfill material. The increase in volume of soil required to restore the original surface grade accounts for compaction.
- (7) Restoration in-kind of original site features, such as wetlands (if required), ground cover, and other vegetation.
- (8) After completion of all of the activities associated with this removal action, a report will be prepared documenting the results.

5.5.1 Effectiveness

Protectiveness : This alternative is very effective in eliminating risks to human health and the environment posed by the site. Excavation ensures that most or all of the impacted soils will be removed from the environment.

TABLE 5-3

COST BREAKDOWN

ALTERNATIVE 3 - ON SITE TREATMENT (BIOREMEDIATION)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DIRECT COSTS				
Treatability Study	1	allowance	\$15,000.00	\$15,000
Excavation	5,440	cubic yds	\$4.00	\$21,760
Biotreatment	5,440	cubic yds	\$25.00	\$136,000
Clean Fill	3,100	cubic yds	\$8.25	\$25,575
Sampling And Analysis (Post-Ex)	30	each	\$55.00	\$1,650
Sampling/Analysis (post-treatment)	54	each	\$55.00	\$2,970
Site Work (Grading, Restoration)	37,785	square ft	\$2.00	\$75,570
Erosion and Sedimentation Control	1	allowance	\$20,000.00	\$20,000
TOTAL DIRECT COSTS				\$298,525
INDIRECT COSTS				
Engineering/Design	1	allowance	\$80,000.00	\$80,000
Construction Misc.	9	months	\$15,000.00	\$135,000
TOTAL INDIRECT COSTS				\$215,000
SUBTOTAL				\$513,525
Contingency (10%)				\$51,353
TOTAL ESTIMATED COST				\$564,878

TABLE 5-4

COST BREAKDOWN
ALTERNATIVE 4 – OFFSITE DISPOSAL (LANDFILL)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DIRECT COSTS				
Excavation	5,440	cubic yds	\$4.00	\$21,760
Transportation	5,440	cubic yds	\$20.00	\$108,800
Disposal	5,440	cubic yds	\$100.00	\$544,000
Clean Fill	7,000	cubic yds	\$8.25	\$57,750
Sampling And Analysis (Post-Ex)	30	each	\$55.00	\$1,650
Site Work (Grading, Restoration)	37,785	square ft	\$2.00	\$75,570
Erosion and Sedimentation Control	1	allowance	\$20,000.00	\$20,000
TOTAL DIRECT COSTS				\$829,530
INDIRECT COSTS				
Engineering/Design	1	allowance	\$50,000.00	\$50,000
Construction Misc.	2	months	\$15,000.00	\$30,000
TOTAL INDIRECT COSTS				\$80,000
SUBTOTAL				\$909,530
Contingency (10%)				\$90,953
TOTAL ESTIMATED COST				\$1,000,483

Incineration is the most effective method destroying contaminants detected in soils at this site, due to the combustive properties of the constituents of concern, providing nearly 100% effectiveness in reducing contaminant concentrations below levels of concern. All ARARs would potentially be met by implementing this method. The long-term protectiveness of this alternative is high.

The short-term protectiveness of this alternative is moderate. The risk of dermal contact with constituents of concern as a result of excavating the site soils is imminent; however, the constituents of concern are not highly dangerous to human health.

Use of Alternatives to Land Disposal : This will be an effective alternative to land disposal if the incinerator utilized for disposal participates in a borrow recycling program.

5.5.2 Implementability

Technical Feasibility :

The technical feasibility of this alternative is moderate, compared with other alternatives. Excavation of the site soils is manageable due to the level terrain and ease of accessibility at the site; however, precautions will have to be taken to avoid creating adverse working conditions. Such conditions may include: unwanted creation of wastewater due to pooling of rainwater in open excavations; erosion and sedimentation by wind or runoff created after the denuding of ground surfaces; and destruction of established vegetation, such as large trees.

Transportation and disposal is accomplished routinely. Several incinerator's which would potentially accept these materials can be identified within one hundred miles of the site. This alternative would be designed to meet ARARs, particularly a SARA requirement that the removal actions should contribute to the efficient performance of long-term removal actions.

Availability : EM&L to implement the excavation and transportation of this alternative are readily available.

Administrative Feasibility : The implementation of this alternative is routine and feasible. Consequentially, the administrative feasibility for this alternative is high. As with any off-site alternative, material loads being removed from the site would require transportation manifests and waste profiles. The likelihood of public and state acceptance of this alternative is high, especially if a TSD facility which utilizes low temperature thermal desorption is selected.

5.5.3 Costs

Total costs to implement this alternative are \$701,283. Details of these costs are presented in Table 5-5.

TABLE 5-5

COST BREAKDOWN

ALTERNATIVE 5 - OFFSITE DISPOSAL (INCINERATION)

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DIRECT COSTS				
Excavation	5,440	cubic yds	\$4.00	\$21,760
Transportation	5,440	cubic yds	\$20.00	\$108,800
Disposal	5,440	cubic yds	\$50.00	\$272,000
Clean Fill	7,000	cubic yds	\$8.25	\$57,750
Sampling And Analysis (Post-Ex)	30	each	\$55.00	\$1,650
Site Work (Grading, Restoration)	37,785	square ft	\$2.00	\$75,570
Erosion and Sedimentation Control	1	allowance	\$20,000.00	\$20,000
TOTAL DIRECT COSTS				\$557,530
INDIRECT COSTS				
Engineering/Design	1	allowance	\$50,000.00	\$50,000
Construction Misc.	2	months	\$15,000.00	\$30,000
TOTAL INDIRECT COSTS				\$80,000
SUBTOTAL				\$637,530
Contingency (10%)				\$63,753
TOTAL ESTIMATED COST				\$701,283

Note:.. Transportation and Disposal costs are provided by Enviro-Tech Mid-Atlantic.

6.0 COMPARATIVE ANALYSIS

Table 6-1 provides a comparative evaluation for each of the five removal alternatives. The objective of the table is to provide a justification for proposing a removal action, based on a rating system. The use of a rating system, such as the one used in the table, is a common method used while conducting Feasibility Studies under CERCLA as a way of presenting the comparison of alternatives.

The rating system depicted in the table is implemented by assigning each of the three criteria (effectiveness, implementability, and cost) a weight in parts of 100-percent. Effectiveness is assigned 35-percent, implementability is assigned 40-percent, and cost is assigned 25-percent. This balance is arbitrary and is determined solely based on engineering judgement.

Further, each sub-criteria (eg., protectiveness) is assigned a portion of the total weight assigned to each criteria. "Protectiveness" is assigned 20-percent and "Use of Alternatives to Land Disposal" is assigned 15-percent, which totals 35-percent for the effectiveness criteria.

A rating between 1 and 5 (best to worst) is given under each sub-criteria to indicate an alternative's relative strength/weakness compared to each of the other alternatives. The rating is then multiplied by the weight of the sub-criteria to calculate the weighted rating for each alternative. The total rating for each alternative is a summation of each weighted rating. The lowest total rating receives the number 1 ranking. Alternative 1 is carried out as an example, as follows:

- 1) The protectiveness of alternative 1 is rated as least effective, compared with the other alternatives, and is given a 5. The 5 rating is multiplied by the 20 weight, equalling 100 weighted rating, as shown in the 3rd column of the table.
- 2) The use of alternatives to land disposal for alternative 1 is rated as least effective and is given a 5. Since alternative 1 would effectively result in land disposing the constituents of concern in an unprotected condition, alternative 1 receives a lower rating than alternative 4. The 5 rating is multiplied by the 15 weight, equalling a 75 weighted rating, as shown in the 5th column.
- 3) The technical feasibility of alternative 1 is rated as most feasible, since implementation of alternative 1 requires very little technical expertise. The 1 rating multiplied by 15 weight equals a 15 weighted rating, as shown in column 7.
- 4) The availability of resources to implement alternative 1 is rated as most feasible, since implementation of alternative 1 requires very few and common resources. The 1 rating multiplied by 10 weight equals a 10 weighted rating, as shown in column 9.
- 5) The administrative feasibility of alternative 1 is rated as least feasible, since this alternative would only possibly be considered as viable by regulatory agencies after a tremendous administrative

TABLE 6-1

COMPARATIVE ANALYSIS OF ALTERNATIVES

ALTERNATIVE	EFFECTIVENESS				IMPLEMENTABILITY						COST (25%)		TOTAL RATING	RANK
	Protective-- ness (20%)		* Alternative to Land Disposal (15%)		Technical Feasibility (15%)		Availability (10%)		Administrative Feasibility (15%)					
Alternative 5	1	20.00	3	45.00	2	30.00	4	40.00	1	15.00	4	100.00	250.00	1
Alternative 3	3	60.00	1	15.00	5	75.00	2	20.00	3	45.00	2	50.00	265.00	2
Alternative 2	3	60.00	1	15.00	4	60.00	2	20.00	4	60.00	3	75.00	290.00	3
Alternative 4	1	20.00	4	60.00	2	30.00	4	40.00	1	15.00	5	125.00	290.00	3
Alternative 1	5	100.00	5	75.00	1	15.00	1	10.00	5	75.00	1	25.00	300.00	5

* Alternative 5 is given a 3 rating, contingent on the using an incinerator which participates in a recycling program.

Alternative 1 = Institutional Controls (see pp.4-1, 5-1,2,3)

Alternative 2 = On-Site Treatment, Thermal (see pp. 4-1, 5-3,4,5)

Alternative 3 = On-Site Treatment, Bioremediation (see pp. 4-1, 5-5,6,7)

Alternative 4 = Off-Site Disposal, Landfill (see pp. 4-1, 5-7,8,9)

Alternative 5 = Off-Site Disposal, Incineration (see pp. 4-1, 5-9,8,10)

effort were put forth to justify that any other removal action would not be in the best interest of human health and the environment. The 5 rating multiplied by 15 weight equals a 75 weighted rating, as shown in column 11.

- 6) The cost of alternative 1 is rated as the most cost-effective. The 1 rating multiplied by 25 weight equals a 25 weighted rating, as shown in column 13.
- 7) The total rating, after summing all weighted ratings, is 300 as shown in column 14.
- 8) The rank of alternative 1 is 5th in comparison to all other alternatives, as shown in the last column.

The proposed removal action is selected based on the alternative receiving the best rank.

7.0 PROPOSED REMOVAL ACTION

The proposed removal action for addressing contaminated soils at Site 17 is off-site disposal at an approved incinerator, as identified by Alternative 5. This conclusion is attained after viewing each sub-criterion as an integral element of the successful remediation of Site 17.

The proposed removal action entails the best overall solution of source control remediation, in which the impacted soils are removed from the environment to eliminate migration of the constituents of concern. If the cost criterion were eliminated, Alternative 5 would also have been selected.

While neither groundwater nor surface water remediation is required, it is recommended that extreme care be taken to avoid impacting the shallow groundwater during remediation. The existing groundwater monitoring wells at Site 17 should be sampled and analyzed for TPHs within 6 months to a year after the restoration phase of the removal action to ensure that removal construction was carried out with respect to avoiding impacts to the groundwater.